Global Hydrology Resource Center

Data User Guide

GPM Ground Validation Upper Air Radiosonde LPVEx

Introduction

The GPM Ground Validation Radiosonde LPVEx dataset consists of sounding data collected as part of the Global Precipitation Measurement (GPM) mission Ground Validation Light Precipitation Validation Experiment (LPVEx). This field campaign took place around the Gulf of Finland in September and October of 2010. The goal of the campaign was to provide additional high altitude, light rainfall measurements for the improvement of GPM satellite precipitation algorithms. The Vaisala RS92 radiosonde was used to produce vertical profiles of atmospheric temperature, pressure, humidity, and winds. The radiosondes were launched from two locations: Kumpula and Vantaa. The Upper Air Radiosonde LPVEx dataset consists of TSV data files and PNG browse image files.

Notice:
The LPVEx field campaign officially took place in September and October 2010, but individual data sets, such as the radiosondes discussed here, provided data beyond the campaign as noted in Table 2. The Kumpula launch site only operated during the field campaign dates while the Vantaa launch site record extends to January 2011. Also, browse imagery is available for the Kumpula sounding launch site, however no imagery is available for the Vantaa site.

Citation

Moisseev, Dmitri N. 2019. GPM Ground Validation Upper Air Radiosonde LPVEx [indicate subset used]. Dataset available online from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A.
DOI: http://dx.doi.org/10.5067/GPMGV/LPVEX/RADIOSONDE/DATA101

Keywords:

NASA, GHRC, PMM, GPM GV, LPVEX, Gulf of Finland, radiosonde, sounding, atmospheric profile

Campaign

The Global Precipitation Measurement mission Ground Validation (GPM GV) campaign used a variety of methods for validation of GPM satellite constellation measurements prior to and after launch of the GPM Core Satellite, which launched on February 27, 2014. The instrument validation effort included numerous GPM-specific and joint agency/international external field campaigns, using state of the art cloud and precipitation observational infrastructure (polarimetric radars, profilers, rain gauges, and disdrometers). These field campaigns accounted for the majority of the effort and resources expended by GPM GV (Ground Validation) mission. More information about the GPM mission is available at the PMM Ground Validation webpage.

The Light Precipitation Validation Experiment (LPVEx) sought to characterize high-altitude, light precipitation systems by evaluating their microphysical properties and utilizing remote sensing observations and models. This campaign was a collaborative effort between the CloudSat mission, GPM GV mission, the Finnish Meteorological Institute, Environment Canada, the United Kingdom National Environmental Research Council, Vaisala Inc., and the University of Helsinki. The campaign took place in September and October of 2010 in Northern Europe in the areas surrounding the Gulf of Finland. One of the objectives of the experiment was to evaluate the performance of satellite measurements when estimating rainfall intensity in high altitude regions. This data collection had the purpose of improving high-altitude rainfall estimation algorithms and understanding of light rainfall processes. The campaign utilized coordinated aircraft flights, atmospheric profile soundings, ground precipitation gauges, radar measurements, and coordinated satellite observations to obtain light precipitation properties and the spatial distribution of those properties. More information about the GPM LPVEx campaign can be found on the LPVEx Field Campaign webpage.

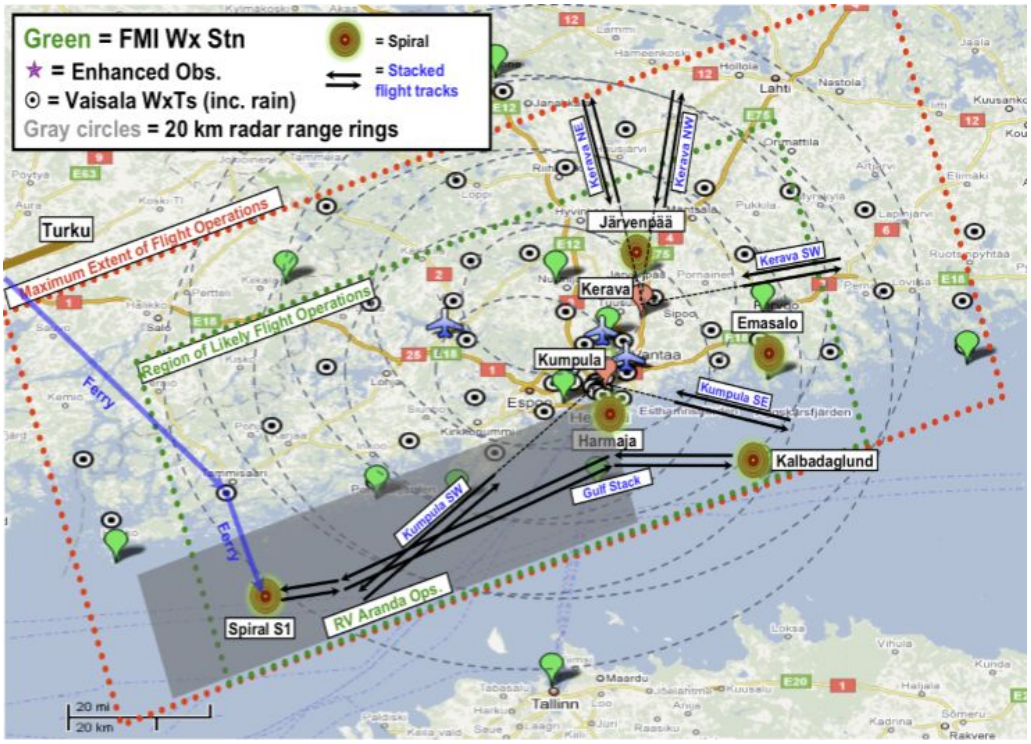

Figure 1: LPVEx field campaign study area along the Gulf of Finland
(Image source: LPVEx Science Plan)

Instrument Description

This dataset includes data from two sounding launch sites (Table 1) in the Kumpula neighborhood of Helsinki, Finland and at Vaisala (a Finnish company that produces industrial and weather/environmental measurement instruments, equipment, and other products) headquarters in Vantaa, a neighboring city of Helsinki, Finland. These launch sites were located near the C-band weather radars used during the campaign. The Kumpula launch site utilized a Vaisala MARWIN Sounding System MW12. The system consists of a receiver/processor and antennas; used to track the radiosonde as it is carried by the balloon and to receive and process its data. The Vantaa launch site utilized a Vaisala Automatic Sounding System. The system is able to launch automated soundings in varying weather conditions. It utilizes a small scale Vaisala Automatic Weather Station that collects meteorological ground measurements to provide the sonde with ground reference data.

The Vaisala Radiosonde RS92 was used during the LPVEx field campaign. The radiosonde is attached to the bottom a the sounding balloon that lifts the device from the surface through the atmosphere. This instrument provides vertical atmospheric profiles of temperature, pressure, humidity, and wind. The radiosonde consists of a rod type capacitive temperature sensor, a silicon capacitive pressure sensor, and heated twin humidity sensors along with a GPS device. The radiosonde GPS signal is used to calculate the wind data. As the radiosonde rises through the atmosphere, the sounding systems are receiving and processing the data.

More information on the current Vaisala sounding systems and radiosondes can be found in the instrument links below. These are the most recent system models, therefore there might be some differences from the models used during the campaign in 2010.

Vaisala MARWIN MW32
AUTOSONDE AS41 DigiCORA Sounding System MW41
Radiosonde RS92

Table 1: Sounding station locations

Station	Latitude	Longitude
Kumpula	60.20	24.96
Vantaa (3 Vaisala test field launch sites)	60.2819	24.8778
	60.2824	24.8772
	60.2825	24.8770

Investigators

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Data Characteristics

The GPM Ground Validation Upper Air Radiosonde LPVEx dataset files are stored as tab-separated values (TSV) files at Level [1B] processing level. More information about the NASA data processing levels is available on the EOSDIS Data Processing Levels webpage. There is one TSV file per sounding launch. These sounding files are distinguished by their launch location (Kumpula or Vantaa) and their date and time of launch. The sounding plot images are stored as PNG files.

Table 2: Data Characteristics

Characteristic	Description
Platform	Ground stations: Vaisala MARWIN Sounding System MW12 Vaisala Automatic Sounding System
Instrument	Vaisala Radiosonde RS92
Projection	n/a
Spatial Coverage	N: 61.01 , S: 58.8 , E: 26.96 , W: 24.96 (Gulf of Finland)
Spatial Resolution	5-10 m
Temporal Coverage	September 15, 2010 - January 28, 2011
Temporal Resolution	1 hour -< 1 day
Sampling Frequency	2 seconds
Parameter	Temperature, wind, humidity, pressure
Version	1

Processing Level	1B

File Naming Convention

The GPM Ground Validation Upper Air Radiosonde LPVEx dataset files are in TSV file format with browse image files in PNG format, named with the following convention:

Data files: lpvex_<site>_YYYYMMDD_<time>.tsv
Browse files: lpvex_Kumpula_YYYYMMDD_hhmm.png

Table 3: File naming convention variables

Variable	Description
<site>	Site of sounding system: Kumpula Vantaa
YYYYMMDD	Date of data in YYYYMMDD where: YYYY = Four-digit year MM = Two-digit month DD = Two-digit day
<time>	Time of sounding in hhmmss or hhmm where: hh = Two-digit hour in UTC mm = Two-digit minute in UTC ss = Two-digit second in UTC
.tsv	Tab-separated values file
.png	Portable Network Graphics file

Data Format and Parameters

The GPM Ground Validation Upper Air Radiosonde LPVEx dataset includes data files in TSV file format and browse images in PNG file format. The Vaisala Radiosonde RS92 collected vertical atmospheric profile information including temperature, winds, pressure, and humidity. This information is contained within each file, with one file per sounding. The browse files contain images of thermodynamic diagrams used to plot the sounding data (only available for the Kumpula sounding location).

The TSV file structure differs for the two sounding locations due to the differing sounding systems used at each site. For the Kumpula site, each TSV file contains a header with information on map name, sounding set, rs-number, data record length, number or data records, max filemap size, data header size, free space in map, status flag, and data variables. Following the header are the sounding data values, listed chronologically from top to bottom with each column, from left to right, indicating a certain data variable. Descriptions for these variables are listed in Table 4 below. For example, the data field in the first row of Table 4 corresponds with the first column of data values in the TSV file, continuing with the seconding row corresponding to the second column and so on.

Table 4: Data Fields for Kumpula TSV files

Field Name	Description	Data Type	Unit
time	Time from start of sounding	float	sec
Pscl	Scaled logarithmic pressure (4096* ln P)	float	ln scaled
T	Temperature	float	K
RH	Humidity	float	%
v	Wind speed, north component	float	m/s
u	Wind speed, east component	float	m/s
Height	Height	float	m
P	Pressure	float	hPa
TD	Dew point	float	K
MR	The ratio of the mass of the water vapor to the mass of the dry air (mixing ratio)	float	g/kg
DD	Wind direction	float	dgr
FF	Wind speed	float	m/s
AZ	Sonde azimuth angle	float	dgr
El	Sonde elevation angle	float	dgr
Range	Sonde distance	float	m
Lon	Sonde longitude coordinate	float	dgr
Lat	Sonde latitude coordinate	float	dgr
SpuKey	System define significant point	Unsigned short	bitfield
UsrKey	User define significant point	Unsigned short	bitfield
RadarH	Height from radar	float	m

Note: A value of "-32768" means missing data.

The Vantaa TSV files also list the sounding data values chronologically from top to bottom with each of the columns corresponding to a certain data variable, however, these files do not include a header. The data field variables for the Vantaa TSV files are listed in Table 5 below, where the same row/column reading pattern from the Kumpula TSV files applies.

Table 5: Data Fields for Vantaa TSV files

Field Name	Description	Unit
mm	Minute	-
ss	Second	-
height	Height of sounding in geopotential meters (meters above mean sea level)	gpm
pressure	Pressure	hPa
temp.	Temperature	degrees C
RH	Relative Humidity	%

dewp.	Dew point temperature	degrees C
WD	Wind direction	degrees
WS	Wind speed	m/s
Level type*	Indicates whether the level is a significant level or other special level	-
comments*	Additional information about the data collected	-

*These level types and comments are indicated by different flag values listed in Table 6 below. More details about this radiosonde data format can be found in the PI documentation and in this UCAR Vaisala radiosonde dataset document.
Note: Missing values are indicated by "///// " but the number of "/ " depends on the variable.

Table 6: Flag values for "Level type" and "comments" fields

Flag value	Description
T	Significance level of temperature
U	Significance level of humidity
d	Significance level of wind direction
f	Significance level of wind speed
v	Significance level of wind using vector criteria
Tr	Tropopause
Pi	Pressure interpolated
Ti	Temperature interpolated
Ui	Humidity interpolated
Wi	Wind interpolated

Algorithm

A radiosonde is attached to a sounding balloon that lifts the sonde through the atmosphere. The radiosonde uses its sensors to measure temperature, humidity, and pressure as it rises. The wind data are calculated using the signal from the radiosonde GPS receiver. All of the data collected by the radiosonde are received and processed by the sounding system.

Quality Assessment

The radiosondes undergo a ground check prior to launch to verify that temperature, humidity, and settings for the radiosonde are properly referencing ground measurements. The radiosondes are also calibrated to meet SI standards and measurement uncertainties determined from recommendations by the Joint Committee for Guides in Metrology.

Software

No software is required to view these data files. The GPM Ground Validation Upper Air Radiosonde LPVEx TSV files can be viewed in a text editor or in a spreadsheet software, such as Microsoft Excel or Notepad++.

Known Issues or Missing Data

For the Kumpula sounding files, a value of "-32768" means missing data. For the Vantaa sounding files, a value of " ///// " means missing data (the number of "/" depends on the variable). The Kumpula launch site only operated during the field campaign dates and therefore has a shorter record while the Vantaa launch site record extends to January 2011. There is no browse imagery available for the Vantaa sounding site.

References

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Related Data

All data from other instruments collected during the LPVEx field campaign are considered related datasets. These data can be located by searching 'LPVEX' in HyDRO 2.0 and are also listed below:

GPM Ground Validation Pluvio Precipitation Gauge LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/PLUVIO/DATA301)

GPM Ground Validation Cloud Spectrometer and Impactor (CIP) LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/PROBES/DATA201)

GPM Ground Validation Wyoming Cloud Radar (WCR) LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/WCR/DATA101)

GPM Ground Validation Satellite Simulated Orbits LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/OVERPASS/DATA401)

GPM Ground Validation Special Sensor Microwave Imager/Sounder (SSMI/S) LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/SSMIS/DATA101)

GPM Ground Validation Wyoming King Air Cloud Microphysics LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/MULTPLE/DATA202)

GPM Ground Validation Autonomous Parsivel Unit (APU) LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/APU/DATA301)

GPM Ground Validation Two-Dimensional Video Disdrometer (2DVD) LPVEx
(http://dx.doi.org/10.5067/GPMGV/LPVEX/2DVD/DATA301)

Contact Information

To order these data or for further information, please contact:

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Created: 04/01/19
Updated: 05/03/19